Euscorpius

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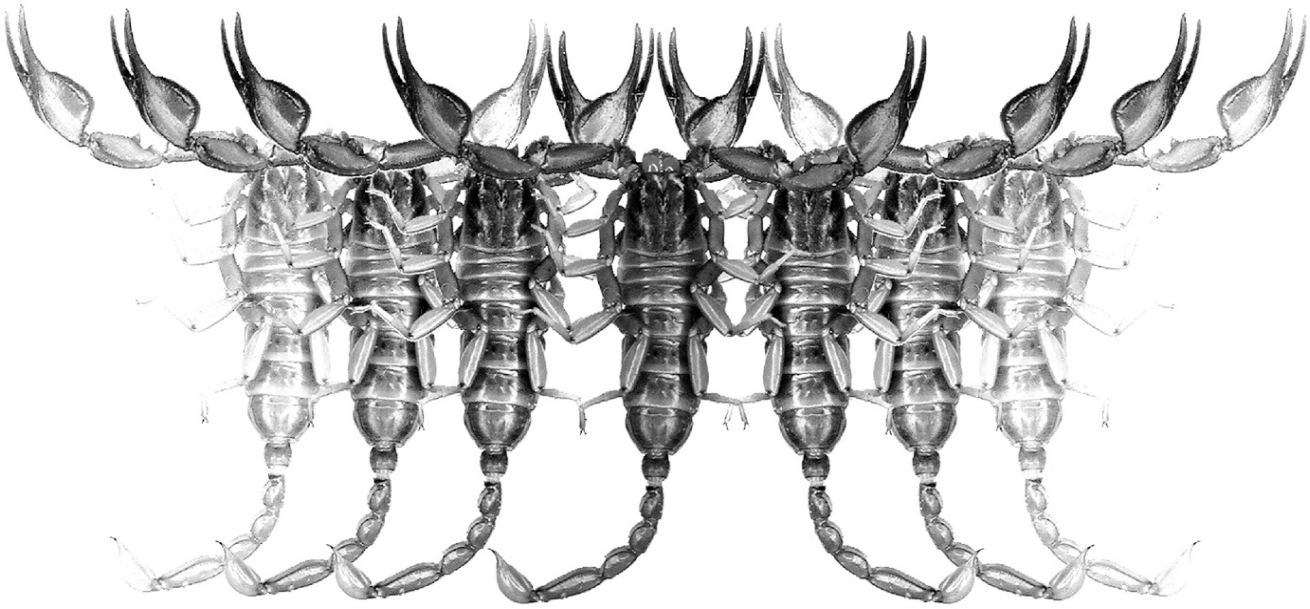

Two new *Chaerilus* from Thailand and Laos (Scorpiones: Chaerilidae)

František Kovařík, Graeme Lowe, Mark Stockmann & František Šťáhlavský

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Derivatio Nominis

The name ***Euscorpius*** Thorell, 1876 refers to the most common genus of scorpions in the Mediterranean region and southern Europe (family Euscorpiidae).

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Euscorpius — Occasional Publications in Scorpiology. 2020, No. 324

Two new *Chaerilus* from Thailand and Laos (Scorpiones: Chaerilidae)

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Summary

Chaerilus kautti **sp**. **n**. from Thailand and *C. pulcherrimus* **sp**. **n**. from Laos are described and fully illustrated with color photographs of live and preserved specimens. *C. kautti* **sp**. **n**. is characterized by the unique combination of two characters: movable finger of pedipalp with 11 imbricated rows of granules; and pedipalp chela length/width ratio in male 4.55. *C. pulcherrimus* **sp**. **n**. is characterized by the unique combination of four characters: movable finger of pedipalp with 8 imbricated rows of granules; total length 16–19 mm; pedipalp chela length/width ratio in male 2.57, in female 2.69; and sternite VII smooth. In addition to analysis of external morphology and hemispermatophores, we also specify the number of chromosomes of both species: *C. kautti* **sp**. **n**. (2n=118) and *C. pulcherrimus* **sp**. **n**. (2n=102).

Introduction

Chaerilidae comprise a small, rather homogeneous, monotypic family of scorpions widely distributed across the continent and archipelagoes of tropical southern Asia (Kovařík et al., 2018). In the sole genus *Chaerilus* Simon, 1877, two macroscopic biometric characters exhibit very high variation compared to those of other scorpion genera. These are: (i) body size, with total length ranging from 16 mm (*C. sejnai* Kovařík, 2005) to 80 mm (*C. tichyi* Kovařík, 2000); and (ii) subdivision of dentition on pedipalp chela movable fingers, ranging from 7 (*C. celebensis* Pocock, 1894) to 16 (*C. majkusi* Kovařík et al., 2018) imbricated rows of granules. Additionally, a great range of variation was also observed in the diploid number of chromosomes within *Chaerilus* (2n=76–186) (Kovařík et al., 2018). The two new species described here have intermediate values of these characters, except for *C. pulcherrimus* **sp**. **n**. which attains the lower extreme of body size.

Methods, Material & Abbreviations

Nomenclature and measurements follow Stahnke (1971), Kovařík (2009), and Kovařík & Ojanguren Affilastro (2013), except for trichobothriotaxy (Vachon, 1974). Hemispermatophore terminology follows Kovařík et al. (2018). Karyotype analyses were based on chromosome preparations obtained by the spreading technique already used in scorpions (e. g. Kovařík et al., 2009). The chromosomes were stained by 5% Giemsa solution in Sörensen phosphate buffer for 20 min. Their structure was then documented by an Olympus AX70 Provis microscope equipped with an Olympus DP72 camera and QuickPHOTO CAMERA v2.3software (Promicra).

Specimen depository: FKCP (František Kovařík, private collection, Prague, Czech Republic; will in future be merged with the collections of the National Museum of Natural History, Prague, Czech Republic).
Morphometrics: D, depth; L, length; W, width.

Systematics

Family **Chaerilidae** Pocock, 1893

Chaerilus Simon, 1877

(Figures 1–86, Table 1)

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Chaerilus Simon, 1877: 238; Kovařík & Ojanguren, 2013: 131–145, figs. 617–776 (complete reference list until 2013); Kovařík et al, 2015: 1–21, figs. 1–91, tables 1–3; Kovařík et al., 2018: 1–27, figs. 1–125, tables 1–2; Kovařík, 2019: 1–9, figs. 1–58, table 1.
= *Chelomachus* Thorell, 1889: 583 (syn. by Kraepelin, 1899: 157).
= *Uromachus* Pocock, 1890: 250 (syn. by Kraepelin, 1899: 157).

Type species. *Chaerilus variegatus* Simon, 1877

Diagnosis. Total length 16–80 mm; trichobothrial pattern orthobothriotaxic type B; pedipalp femur d_3–d_4 trichobothrial axis angled toward dorsoexternal carina; patella with 3 ventral trichobothria, femur with 9 trichobothria (4 dorsal); cheliceral fixed finger with median and basal denticles flush on surface, not fused into bicusp; ventral margin of

Figures 1–**2**. *Chaerilus kautti* **sp**. **n**., male holotype (1) and female paratype (2) in vivo habitus.

cheliceral movable finger crenulated, dorsal margin with single subdistal denticle; ventral surface of cheliceral fixed finger with 4–8 denticles; sternum, *type 1*, exhibiting subtle, wide horizontal compression; lateral eyes usually composed of 2 large major ocelli, eyespot present; maxillary lobes I spatulate; hemispermatophore fusiform; ovariuterus 6-celled, embryonic development apoikogenic; lateral lymphoid organs absent; stigmata oval or round; median denticle row (MD) of pedipalp chela finger arranged in oblique groups; pedipalp chela with 8-carina configuration; legs without tibial spurs, but with prolateral and retrolateral pedal spurs; tarsi of legs with 2–4 rows of ventral setae and a median row of spinules; fifth metasomal segment with a single ventral carina; telson without subaculear tubercle; sclerotized cuticle of integument with weak or no autofluorescence emission under ultraviolet (UV) excitation.

Chaerilus kautti **sp. n.**

(Figures 1–50, 84, Table 1)

http://zoobank.org/urn:lsid:zoobank.org:act:8275997C-69A8-4494-A6F1-ED502A69E1FF

Type locality and type repository. **Thailand**, Prachuap Khiri Khan Province, Khao Ma Rong Cave, 11.2021900°N 99.4946250°E, 56 m a. s. l., FKCP.

Type material (FKCP). **Thailand**, Prachuap Khiri Khan Province, Khao Ma Rong Cave, 11.2021900°N 99.4946250°E, 56 m a. s. l. (Fig. 48), 19.VIII.2018, 1♂ (holotype, **1770**, Figs. 1, 3–4, 7–8, 15, 20–32, 44–47), leg. Peter Kautt, 1♀ (paratype, Figs. 2, 5–6, 9–14, 16–19, 33–43, 49–50, scorpion born 27.IX.2020), leg. Britta & Mark Stockmann, 16 juvs. (paratypes, Figs. 49–50, offspring of the female paratype 27.IX.2020, still alive), bred by F. Kovařík and M. Stockmann.

Etymology. The specific epithet is a patronym honoring Peter Kautt, the collector of the male holotype of the new species.

Diagnosis (♂♀). Total length 37–43 mm; two pairs of lateral eyes and one pair of median eyes; ventral surface of cheliceral fixed finger with 4 denticles; male differs from female in having pedipalp chela much narrower; chela length/width ratio ♂ 4.55, ♀ 2.88; movable finger of pedipalp with 11 imbricated rows of granules; fingers straight in both sexes; pedipalp chela with 7–8 carinae; pectinal tooth count ♂ 6, ♀ 4; carapace granulated sparsely in male, densely in female; mesosomal tergites granulated, mainly in the female; all sternites smooth without carinae and granules; metasoma I–III with 6 or 8 carinae, ventral carinae may be absent.

Description. Total length ♂ 37 mm, ♀ 43 mm; color reddish orange to brown, maculose; chelicerae (Figs. 42–43) sparsely granulated dorsally, yellow and strongly reticulate, anteriorly black; male differs from female in having pedipalp chela much narrower with short fingers; chela length/width ratio ♂ 4.55, ♀ 2.88; male with larger pectines (Figs. 8 and 10); no sexual dimorphism in shape of metasoma and telson; trichobothrial pattern as shown in Figs. 23–29, measurements in Table 1.

Carapace and mesosoma (Figs. 7–10). Carapace covered by large granules in female, almost smooth in male; anterior margin of carapace weakly concave; two well developed pairs of lateral eyes and one pair of median eyes present; mesosomal tergites irregularly granulated in female, almost smooth in male; all sternites smooth without carinae and granulation; sternite V with smooth patch present; pectinal tooth count ♂ 6, ♀ 4.

Metasoma and telson (Figs. 15–22). Metasoma I–II with 6 or 8 incomplete carinae, ventral carinae reduced or absent; metasoma IV with 8 carinae, metasoma V with 5 carinae; all carinae composed of sparse, large granules; intercarinal surfaces sparsely, irregularly granulated, more so on lateral surfaces of all segments, and ventral surfaces of segment V; metasomal segments I–III ventrally smooth; all segments very sparsely hirsute; telson elongate, ampullate, smooth, very sparsely hirsute.

Pedipalps (Figs. 23–41). Pedipalp chela elongated in male, rather stout in female; movable finger with 11 and fixed finger with 10 imbricated rows of granules; chela with 7 or 8 carinae, smooth in male, partly finely granulated in female; carina on dorsoexternal surface of the manus may be incomplete; dorsal and internal surfaces of chela with reticulate granulation patterns; patella with 5–6 smooth carinae, surfaces of patella smooth except internal surface which is finely granulated; femur densely granulated with 4 carinae.

Legs (Figs. 11–14). Hirsute, without bristlecombs and carinae; femora and patellae granulated dorsally, other surfaces smooth; tarsomeres with 4 rows of spiniform setae; spiniform seta formula of inner rows 6–7/7–8 : 7–8/6–7 : 7–8/8–9 : 6–8/8–9; of outer rows 3–4/3–4 on all legs.

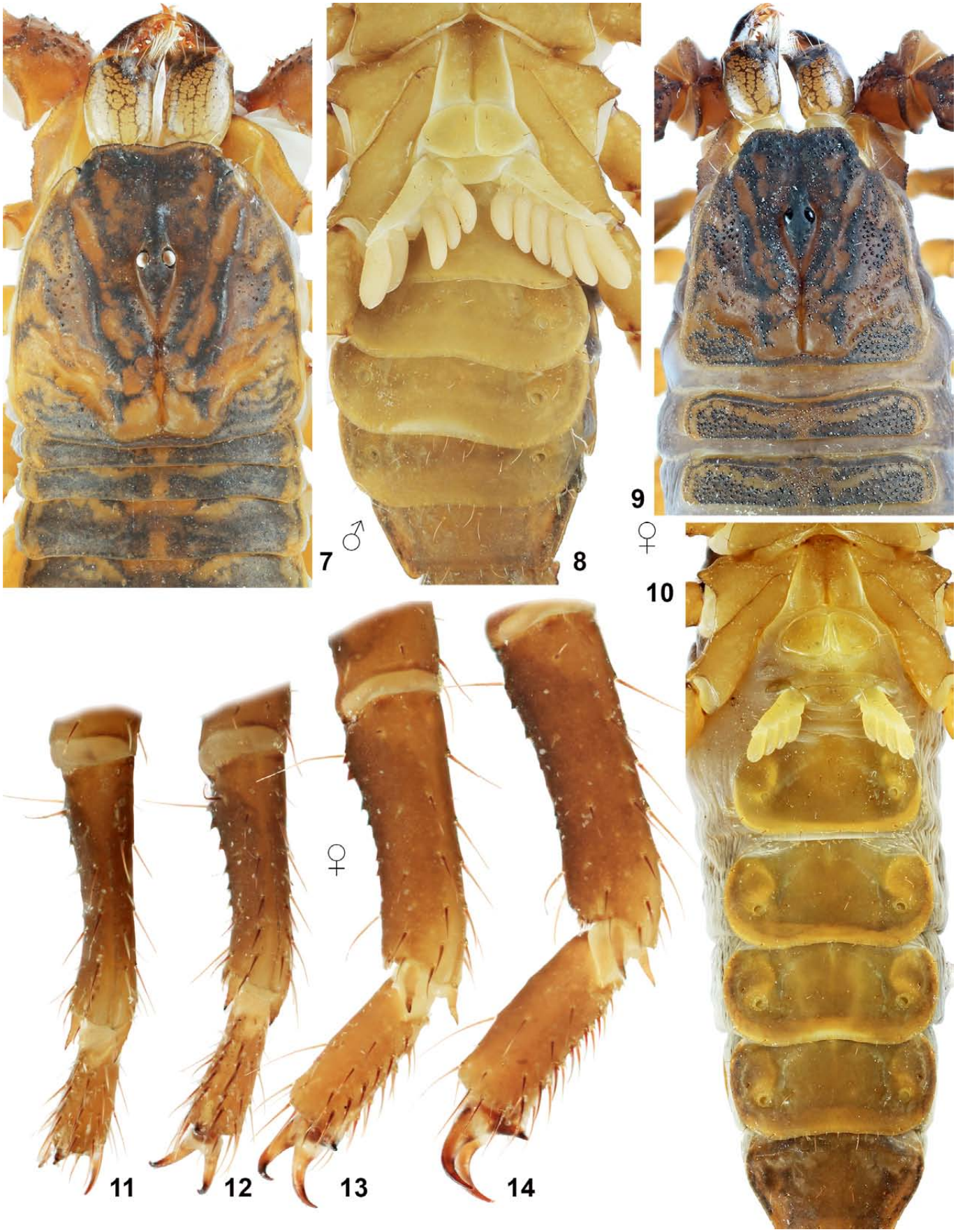
Hemispermatophore (Figs. 44–47). Fusiform; distal lamina short, broad, weakly tapered, apex rounded; capsule with distal carina weakly sclerotized; sperm hemiduct delineated by two thin, sclerotized carinae, of which the distal is longer, the basal shorter; trunk long, as broad as capsule. Measurements of right hemispermatophore (mm): distal lamina length 0.64, capsule length 0.72, trunk length 1.96, pedicel length 0.42, capsule width 0.63. Left hemispermatophore with shorter trunk, length 1.70.

Karyotype (Fig. 84). Male holotype was analyzed. During metaphase I 59 bivalents were observed (Fig. 84), implying that 2n=118. Chiasmata were not observed during meiosis.

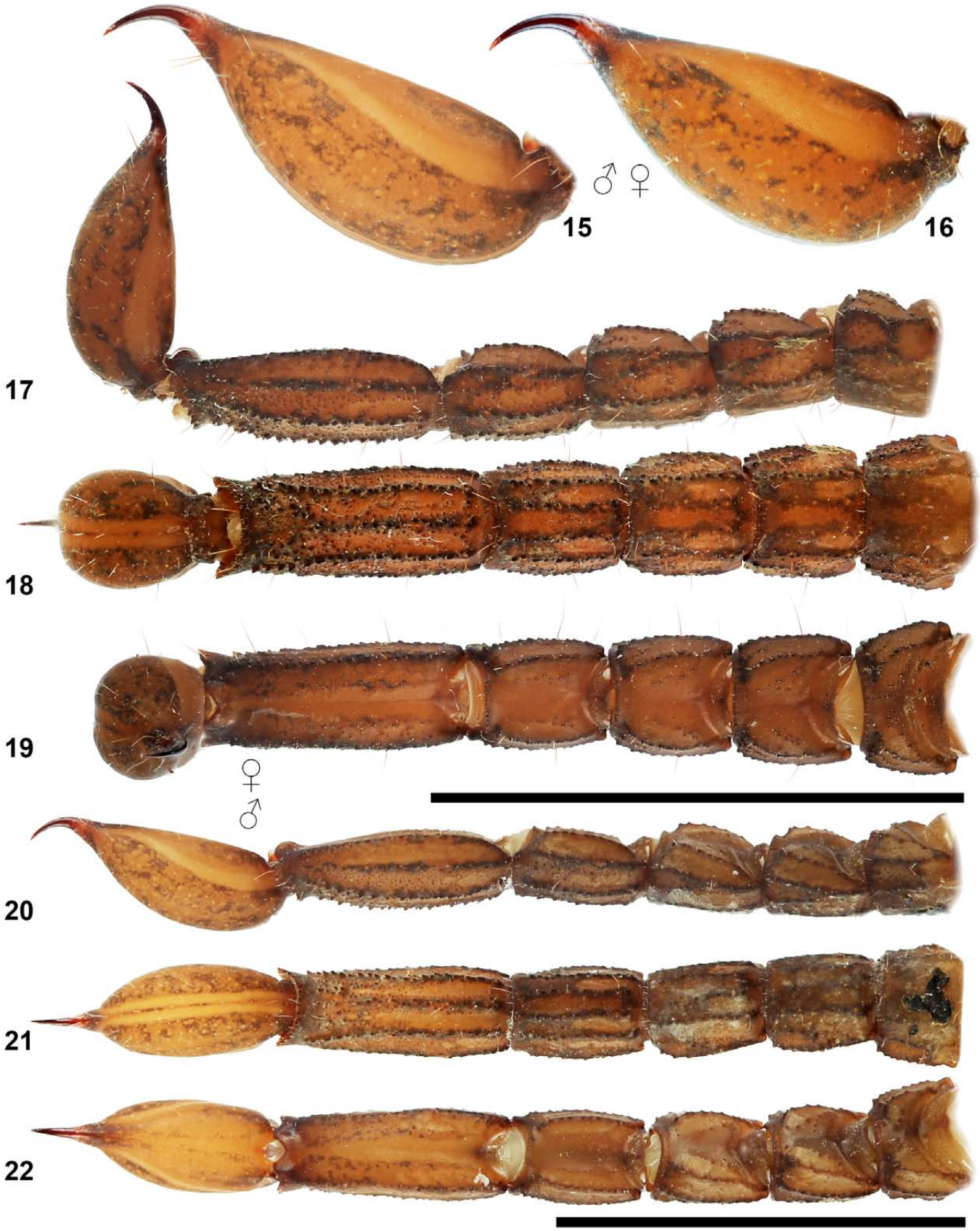
Affinities. *Chaerilus kautti* **sp. n.** is reliably distinguished from all other *Chaerilus* species by the following unique combination of two characters: movable pedipalp finger with 11 imbricated granule rows; and pedipalp chela length/width ratio 4.55 in the male.

A movable pedipalp finger with 11 (or 10–11) imbricated granule rows is also found in six other species of the genus (*C. cimrmani* Kovařík, 2012 from Thailand, *C. hofereki* Kovařík, 2014 from Vietnam, *C. julietteae* Lourenço, 2011 from

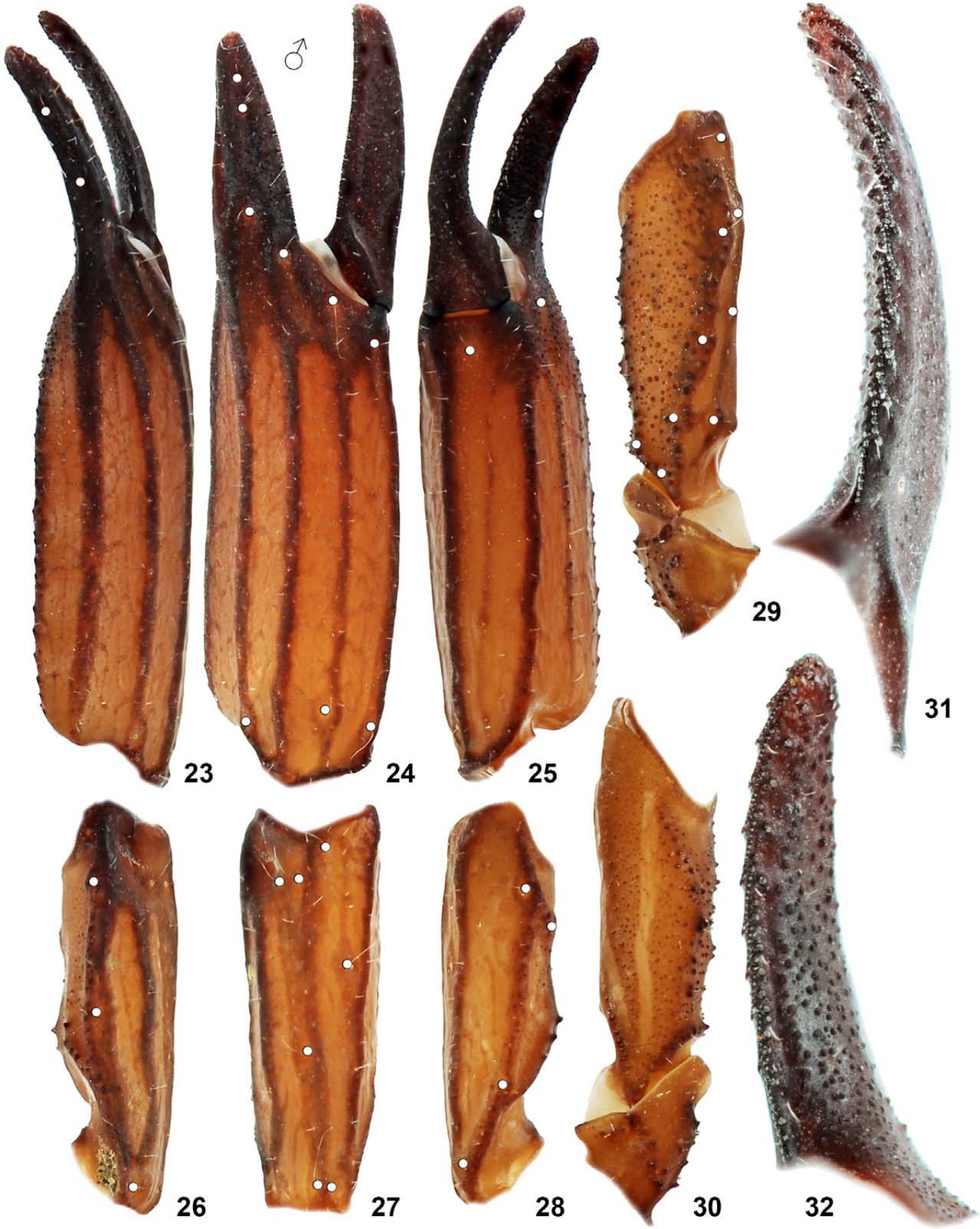
Figures 3–**6**: *Chaerilus kautti* **sp**. **n**. **Figures 3**–**4**. Holotype male, dorsal (3) and ventral (4) views. **Figures 5**–**6**. Paratype female, dorsal (5) and ventral (6) views. Scale bar: 10 mm.



Figures 7–14: *Chaerilus kautti* **sp. n. Figures 7–8**. Holotype male, carapace and tergites I–III (7), and sternopectinal region and sternites (8). **Figures 9–14**. Paratype female, carapace and tergites I–II (9), sternopectinal region and sternites (10), left legs I–IV, retrolateral aspect (11–14).



Figures 15–**22**: *Chaerilus kautti* **sp**. **n**. **Figures 15**, **20**–**22**. Holotype male, telson lateral (15), metasoma and telson, lateral (20), ventral (21), and dorsal (22) views. **Figures 16**–**19**. Paratype female, telson lateral (16), metasoma and telson, lateral (17), ventral (18), and dorsal (19) views. Scale bars: 10 mm (17–19, 20–22).



Figures 23–**32**. *Chaerilus kautti* **sp**. **n**., holotype male, pedipalp chela, dorsal (23), externodorsal (24), and ventrointernal (25) views. Pedipalp patella, dorsal (26), external (27) and ventrointernal (28) views. Pedipalp femur and trochanter, dorsalointernal (29) and ventral (30) views. Movable (31) and fixed (32) fingers dentition. The trichobothrial pattern is indicated in Figures 23–29.

Figures 33–**41**. *Chaerilus kautti* **sp**. **n**., paratype female, pedipalp chela, dorsal (33), external (34), and ventrointernal (35) views. Pedipalp patella, dorsal (36), external (37) and ventral (38) views. Pedipalp femur and trochanter, dorsalointernal (39) and ventral (40) views. Movable finger (41) dentition.

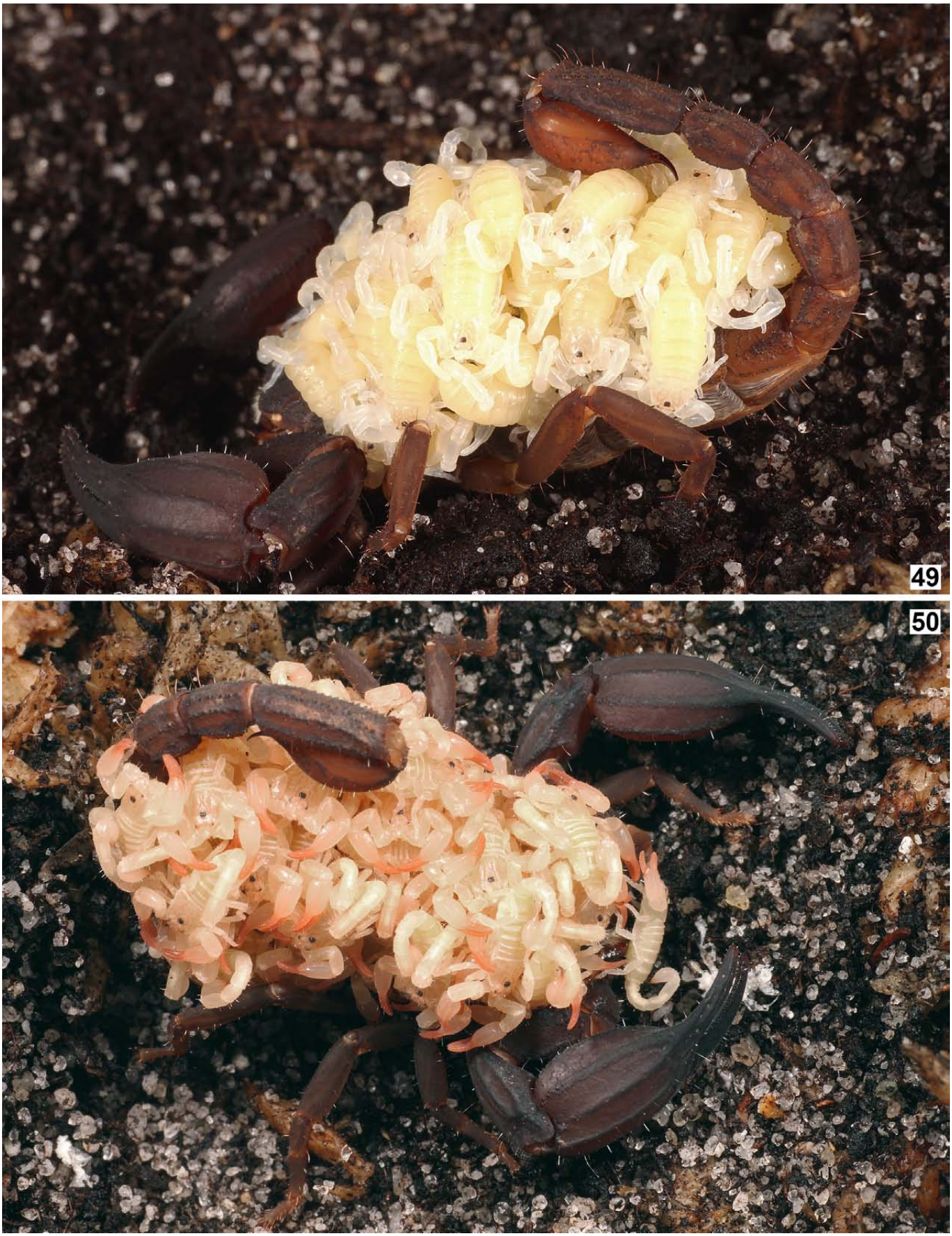
Figures 42–43. *Chaerilus kautti* **sp. n.**, paratype female, left chelicera dorsal (42) and ventral (43) views.

Vietnam, *C. neradorum* Kovařík et al., 2018 from Thailand, *C. robinsoni* Hirst, 1911 from Malaysia and Indonesia, and *C. stockmannorum* Kovařík et al., 2018 from Thailand). However, males of all of these species have a pedipalp chela length/width ratio between 1.84 (*C. hofereki*) and 3.13 (*C. julietteae*).

Comments on localities and life strategy. The type locality is located on an isolated karst mountain close to the eastern coast of Thailand, west of Bang Saphan. The entire mountain is clothed in primary forest, but is surrounded by cultivated farmland with mostly oil palms and gumtrees. The type locality is close to two extensive caves, but *C. kautti* **sp. n.** does not appear to be associated with them. Climate conditions are warm and very wet during the wet season from May to November, and slightly cooler and drier during the dry season from December to April. Even during the dry season, the area is very humid and water is always present.

The male from 2018 was collected during heavy rain on a dark night, the female from 2019 on a dry night without wind during a new moon. The average temperatures on both nights were ca. 25–26°C with very high humidity.

Figures 44–48: *Chaerilus kautti* **sp. n. Figures 44–47**. Hemispermatophores of holotype. **Figures 44–45**. Right hemispermatophore, posterior (44) and convex (45) views. **Figure 46**. Left hemispermatophore, convex view. Note: the fissure in the sperm hemiduct is damage from handling, not a natural feature. **Figure 47**. Right hemispermatophore, capsule and distal lamina, convex view, fine refractile structure visualized under Nomarksi illumination. Scale bars: 1 mm (44–46), 500 µm (47). **Figure 48**. Type locality.



Figures 49–**50**. *Chaerilus kautti* **sp**. **n**., paratype female with newborns (40) and with juveniles after first ecdysis (50) in vivo habitus.

Dimensions (mm)		*C. kautti* **sp. n.** ♂ **holotype**	*C. kautti* **sp. n.** ♀ **paratype**	*C. pulcherrimus* **sp. n.** ♂ **holotype**	*C. pulcherrimus* **sp. n.** ♀ **paratype**
Carapace	L / W	5.69 / 5.71	5.23 / 5.68	2.96 / 3.01	2.79 / 2.70
Mesosoma	L	8.81	18.20	4.40	4.10
Tergite VII	L / W	2.05 / 4.38	2.65 / 4.75	1.38 / 2.40	1.13 / 2.32
Metasoma + telson	L	23.03	19.18	11.44	9.50
Segment I	L / W / D	2.28 / 2.87 / 2.20	1.97 / 2.84 / 2.11	1.13 / 1.78 / 1.27	0.90 / 1.20 / 1.00
Segment II	L / W / D	2.67 / 2.36 / 2.20	2.25 / 2.41 / 1.74	1.31 / 1.51 / 1.17	1.04 / 1.16 / 0.88
Segment III	L / W / D	2.82 / 2.29 / 2.13	2.16 / 2.23 / 1.69	1.40 / 1.29 / 1.10	1.12 / 1.09 / 0.95
Segment IV	L / W / D	3.21 / 2.27 / 1.89	2.45 / 2.01 / 1.63	1.48 / 1.29 / 1.17	1.28 / 1.05 / 0.86
Segment V	L / W / D	5.72 / 2.18 / 1.94	4.77 / 1.88 / 1.63	2.61 / 1.29 / 1.15	2.22 / 1.10 / 0.92
Telson	L / W / D	6.33 / 2.20 / 2.19	5.58 / 2.12 / 1.98	3.51 / 1.36 / 1.28	2.94 / 1.34 / 1.04
Pedipalp	L	28.70	19.43	10.05	8.56
Femur	L / W	7.05 / 2.14	4.49 / 1.93	2.32 / 1.04	2.02 / 0.94
Patella	L / W	7.45 / 2.18	4.86 / 2.24	2.62 / 1.24	2.15 / 1.02
Chela	L	14.20	10.08	5.11	4.39
Manus	W / D	3.12 / 3.44	3.50 / 3.29	1.99 / 2.10	1.63 / 1.75
Movable finger	L	5.11	5.40	2.36	2.29
Total	**L**	**37.53**	**42.61**	**18.80**	**16.39**

Table 1. Comparative measurements of adults of *Chaerilus kautti* **sp. n.** and *C. pulcherrimus*. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

Both specimens were found at night on the ground, between leaf litter or sitting openly on rocks. In captivity, the scorpions concealed themselves under bark or in moss. The probably do not excavate burrows, but instead shelter between rocks, or in wood and leaf litter in their habitat.

Other scorpions observed in this habitat were *Heterometrus cimrmani* Kovařík, 2004, *Lychas scutilus* Koch 1845, and *Liocheles australasiae* Fabricius, 1775.

An adult gravid female collected in 2019 gave birth in captivity to 48 juveniles after 11 months.

Chaerilus pulcherrimus sp. n.

(Figures 51–83, 85–86, Table 1)

http://zoobank.org/urn:lsid:zoobank.org:act:D808FDFC-2B57-4BB1-84D1-8A62BE6B63F6

Type locality and type repository. **Laos**, Champasak Province, FKCP.

Type material (FKCP). **Laos**, Champasak Province, 5.VIII.2019, 1♂ (holotype, **1852**, Figs. 51–55, 57–71, 80–83), 1♀ (paratype, damaged, Figs. 56, 72–79, scorpion born 15.VIII.2020), leg. V. Fura, 14 juvs. (paratypes, offspring of the female paratype 15.VIII.2020, 2nd ecdysis 21.IX.2020, 3rd ecdysis 20.X.2020, still alive), bred by F. Kovařík.

Etymology. The specific epithet is derived from the Latin nominative, singular adjective *pulcherrimus* (masculine), a superlative of *pulcher* = beautiful, in reference to the colorful maculose patterns on the carapace, tergites, metasoma and telson of this diminutive species.

Diagnosis (♂♀). Total length 16–19 mm; two pairs of lateral eyes and one pair of median eyes; ventral surface of cheliceral fixed finger with 4 denticles; chela length/width ratio ♂ 2.57, ♀ 2.69; movable pedipalp finger with 8 imbricated granule rows; fingers straight in both sexes; pedipalp chela with 7 carinae; pectinal tooth count ♂ 4, ♀ 3; carapace and mesosoma granulated in both sexes; all sternites smooth without carinae and granules; metasoma I–IV with 6 or 8 carinae, ventral carinae reduced or absent.

Description. Total length ♂ 18.8 mm, ♀ 16.4 mm; color reddish orange to brown, maculose; chelicerae sparsely finely granulated dorsally, yellow and strongly reticulate, anteriorly black; male differs from female in having pedipalp chela slightly narrower with short fingers; chela length/width ratio ♂ 2.57, ♀ 2.69; male with larger pectines; no sexual dimorphism in shape of metasoma and telson; trichobothrial pattern as shown in Figs. 63–69, measurements in Table 1.

Carapace and mesosoma (Figs. 54–55). Carapace covered by large granules in both sexes; anterior margin of carapace almost straight; two well developed pairs of lateral eyes and one pair of median eyes present; mesosomal tergites irregularly granulated, mainly on tergite VII; all sternites smooth without carinae and granulation; sternite V with smooth patch indicated; pectinal tooth count ♂ 4, ♀ 3.

Metasoma and telson (Figs. 56–60). Metasoma I–IV with 6 or 8 incomplete carinae, ventral carinae reduced to absent, dorsal carinae are composed of strong denticles; metasoma V with 5 carinae; intercarinal surfaces sparsely, irregularly granulated, more so on lateral surfaces of all segments and ventral surfaces of segment V; all segments very sparsely hirsute; telson elongate, ampullate, smooth, very sparsely hirsute.

Figure 51. *Chaerilus pulcherrimus* **sp**. **n**., holotype male in vivo habitus.

Pedipalps (Figs. 63–79). Pedipalp chela rather stout with swollen manus mainly in female; movable finger with 8 and fixed finger with 7 imbricated rows of granules; chela with 7 carinae, smooth in both sexes; dorsal and internal surfaces of chela with reticulate granulation patterns; patella with 4–5 smooth, reduced carinae, or carinae absent; surfaces of patella smooth except for internal surface which is sparsely granulated; femur densely granulated with four incomplete carinae.

Legs (Figs. 61–62). Hirsute, without bristlecombs and carinae; femora and patellae smooth; tarsomeres with two rows of spiniform setae; spiniform seta formula 5–6/5–7 : 6–7/6–7 : 7–8/7–8 : 7–8/7–9.

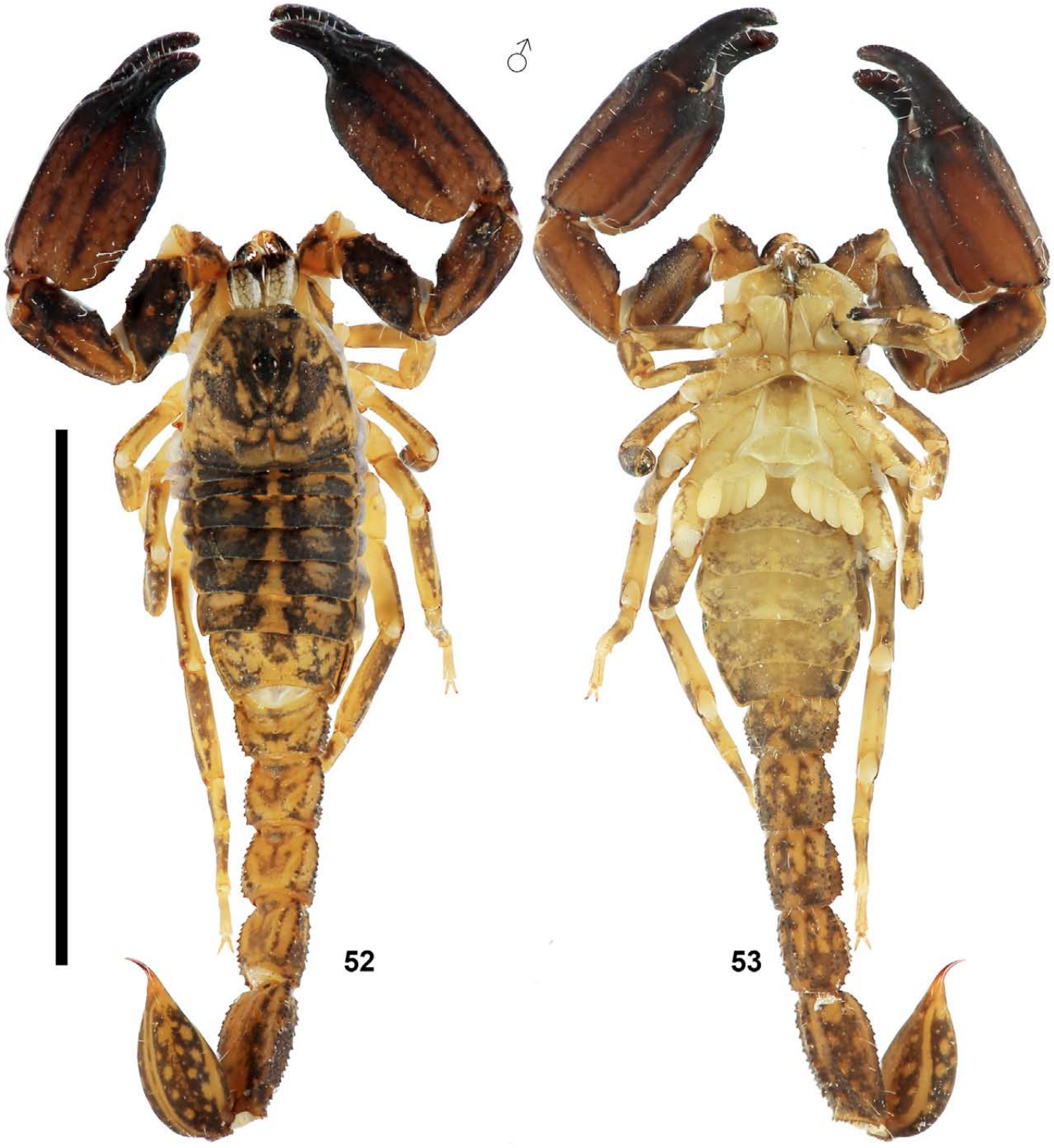
Hemispermatophore (Figs. 80–83). Fusiform; distal lamina short, broad, weakly tapered, apex rounded; capsule with distal carina weakly sclerotized; sperm hemiduct delineated by two thin, sclerotized carinae, of which the distal is longer, the basal shorter; capsule elongate, ca. 50% longer than distal lamina; trunk long, as broad as capsule. Measurements of left hemispermatophore (mm): distal lamina length 0.35, capsule length 0.53, trunk length 1.10, pedicel length 0.22, capsule width 0.30. Right hemispermatophore similar to the left hemispermatophore.

Karyotype (Figs. 85–86). Male holotype was analyzed. The diploid complement is 102 chromosomes in the mitotic metaphases (Fig. 85). During metaphase I, 51 bivalents were observed (Fig. 86), implying that 2n=102. Chiasmata were not observed during meiosis.

Affinities. The described features distinguish *C. pulcherrimus* **sp**. **n**. from all other species of the genus. *C. pulcherrimus* **sp**. **n**. is similar to *C. celebensis* Pocock, 1894 (see key in Kovařík & Ojanguren, 2013: 131–133). These two species can be differentiated by pedipalp chela granulation. The chela has smooth carinae in *C. pulcherrimus* **sp**. **n**. (Fig. 63) vs. granulated carinae in *C. celebensis* (fig. 42 in Kovařík, 2019: 8).

C. pulcherrimus **sp**. **n**. is reliably distinguished from all other *Chaerilus* species by the following unique combination of four characters: movable finger of pedipalp with 8 imbricated granule rows; total length 16–19 mm; pedipalp chela length/width ratio ♂ 2.57, ♀ 2.69; and sternite VII smooth.

Only one other species of the genus was reported from Laos: *C. laoticus* Lourenço & Zhu, 2008. This species differs in having the male pedipalp chela very narrow, with length/width ratio 4.0–4.2.



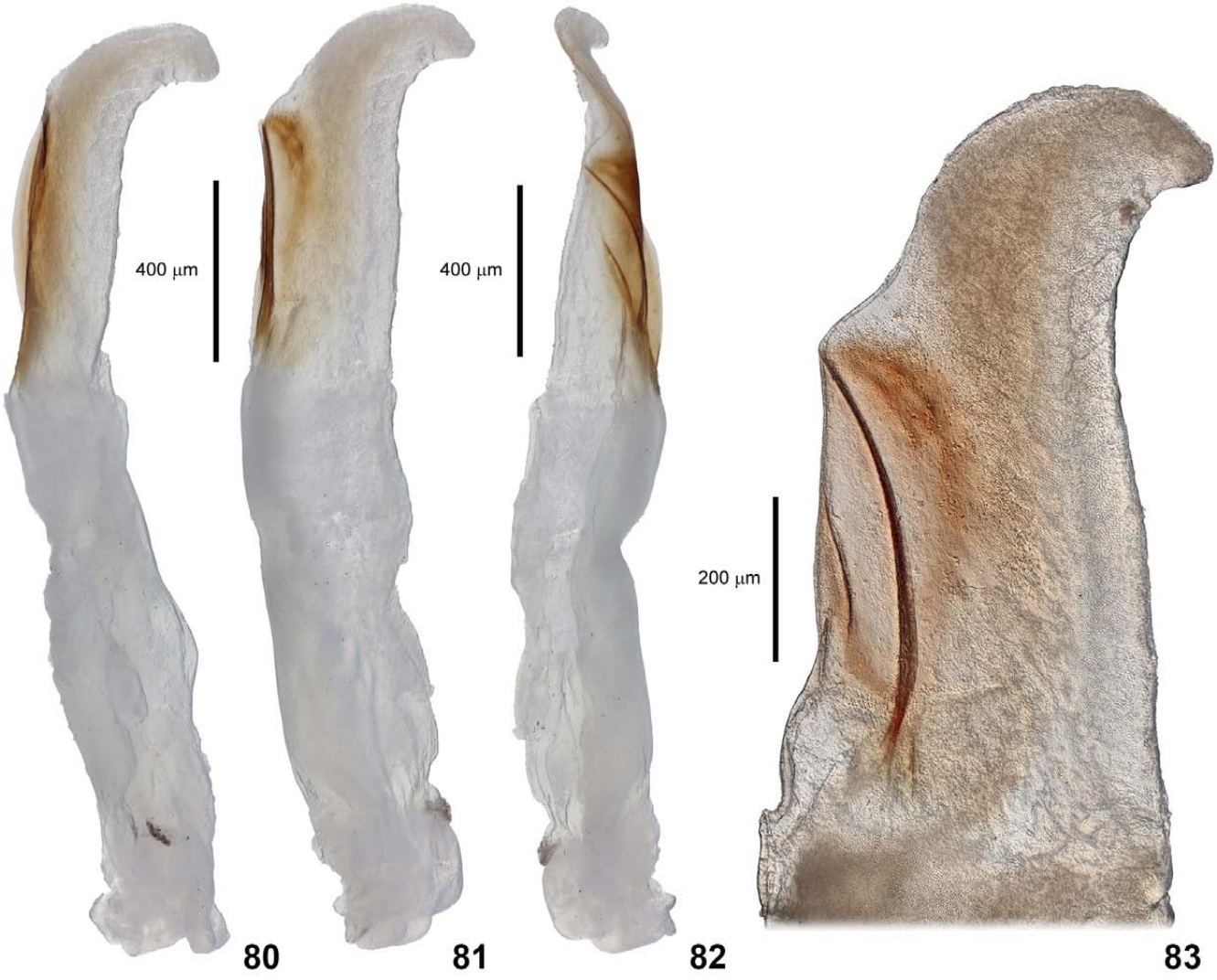
Figures 52–53. *Chaerilus pulcherrimus* **sp. n.**, holotype male, dorsal (52) and ventral (53) views. Scale bar: 10 mm.

Figures 54–55. *Chaerilus pulcherrimus* **sp. n.**, holotype male, carapace and tergites (54), and sternopectinal region and sternites (55).

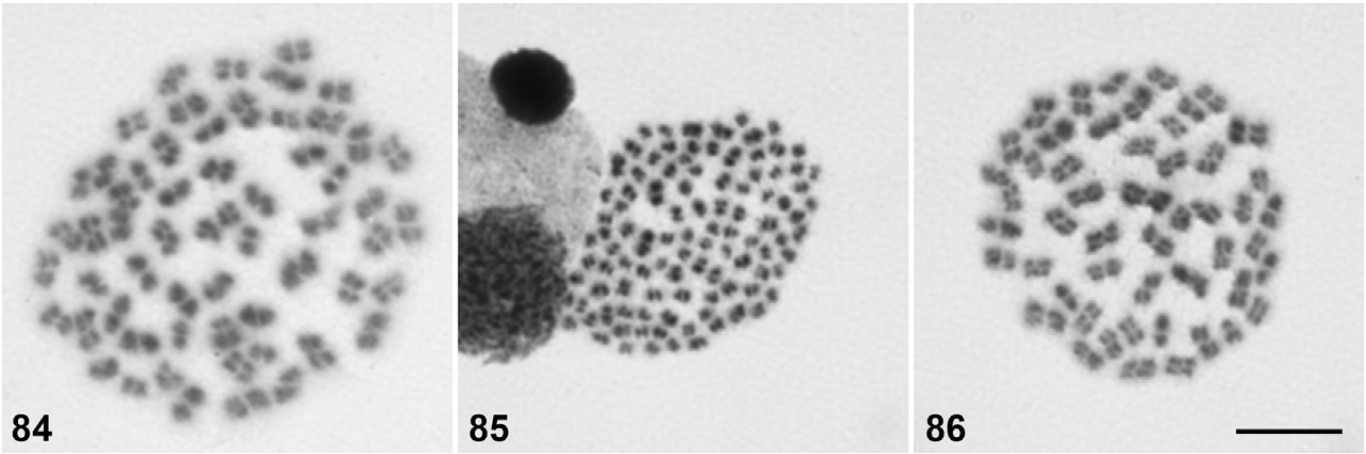
Figures 56–62: *Chaerilus pulcherrimus* **sp**. **n**. **Figure 56**. Paratype female, telson lateral. **Figures 57–62**. Holotype male, telson lateral (57), metasoma and telson, lateral (58), dorsal (59), and ventral (60) views, left legs III–IV, retrolateral aspect (61–62). Scale bar: 5 mm.

Figures 63–**71**. *Chaerilus pulcherrimus* **sp**. **n**., holotype male, pedipalp chela, dorsal (63), externodorsal (64), and ventrointernal (65) views. Pedipalp patella, dorsal (66), external (67) and ventral (68) views. Pedipalp femur and trochanter, dorsalointernal (69) and ventral (70) views. Movable finger (71) dentition. The trichobothrial pattern is indicated in Figures 63–69.

Figures 72–79. *Chaerilus pulcherrimus* **sp. n.**, paratype female, pedipalp chela, dorsal (72), external (73), and ventral (74) views. Pedipalp patella, dorsal (75), external (76) and ventral (77) views. Pedipalp femur and trochanter, dorsalointernal (78) view. Movable finger (79) dentition.



Figures 80–**83**. *Chaerilus pulcherrimus* **sp**. **n**., left hemispermatophore. **Figures 80**–**83**. Whole hemispermatophore in posterior (80), convex (81) and anterior (82) views. **Figure 83**. Capsule and distal lamina, convex view (compressed), fine refractile structure visualized under Nomarksi illumination. Scale bars: 400 μm (80–81, 82), 200 μm (83).



Figures 84–**86**: The chromosomes of *Chaerilus* species. **Figure 84**. *C. kautti* **sp**. **n**., meiotic metaphase I. **Figures 85**–**86**. *C. pulcherrimus* **sp**. **n**., mitotic metaphase (85) and meiotic metaphase I (86). Scale bar: 10 μm.

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